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Book of Abstracts

1st Faculty of Science and Engineering (FSE) Research Conference

Theme: United Nations

Sustainable Development Goals (SDGs)

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Theme: United Nations
Sustainable Development Goals (SDGs)

Hosted by
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Professor Nazira Karodia
Professor Keith Burnham

Preface

It is indeed a pleasure to welcome all participants to the 1st Research Conference organised by the Faculty of Science and Engineering during Career Development Week, February 2020. We have had an excellent response to the call for participation from our Postgraduate Research Student community, resulting in the selection contained in the book of abstracts. These represent a sample snapshot of the current on-going research programmes within the Faculty. The selection indicates a rich and diverse range of topics which are being investigated, extended and developed for the benefit of society at large. The motivation for many of the research programmes align with the United Nations Sustainable Development Goals, which provide the theme for the Research Conference. We trust that you will find the event to be of value and we look forward to networking and meeting with you all during the presentations and poster sessions today.

Dr Subashini Suresh

Prof. Nazira Karodia

Prof. Keith Burnham

17th February 2020

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Research Paper Abstracts

The Role of Team Based Learning to Improve Students' Mathematical Skills and Self Confidence

Abigail Parkes, Liam Naughton and Nazira Karodia

Abstract: Concerns continue to be raised regarding the mathematical preparedness of students entering UK Higher Education (Croft & Lawson, 2017). At the same time widening participation in STEM is a key strategic objective of HE (Cox & Bidgood, 2003). A clear requirement exists for supports to help students improve their mathematics confidence and competence.

The aim of this research is to investigate the effects of Team-Based Learning on students' learning satisfaction, self-confidence and preparedness for STEM HE and to determine how we can assess mathematics confidence and preparedness for STEM HE.

A pilot study took place with students from local colleges who were re-taking GCSE mathematics. The study involved taking elements of the TBL approach and implementing them in a mathematics setting. Within this study students were invited to complete a pre and post course survey investigating various factors associated to previous mathematics attainment and confidence.

The initial findings of the pilot study have shown that there is potential for the TBL approach to increase students' confidence and perceived mathematical ability. The findings also show a positive difference in students' attitudes towards studying at university.

The evidence of the pilot study suggests that the TBL approach could be successful with students at the transition to HE. A follow-on study is now taking place.

Keywords: Mathematics Education, Team-Based Learning, Maths confidence.

Link to UNSDG: Quality Education

The problems and challenges facing teachers who teach computer programming in secondary schools in England (the west midlands region)

Almabrok Almdahem, Kevan Buckley and Nazira Karodia

Abstract: The new national curriculum of study for computing became compulsory in England in September 2014, replacing Information and Communications Technology (ICT) secondary school subject with Computer Science (CS). This introduces a challenge for ICT teachers and students without CS subject knowledge.

Computer programming (CP) is becoming increasingly important in many societies in the world today. It is necessary for educational institutions in order to perform several educational operations. However, the teaching of programming in many secondary educations has not been well developed. Interest in this area is new and the amount of research conducted in the field is still limited.

In this paper, an attempt is made to highlight the challenges and problems facing teachers, which are as follows: (a) teaching methods of CP in secondary schools (b) difficulties in the implementation of the curriculum in schools. Furthermore, this study seeks to identify what needs to be done to improve the learning and teaching of CP along with the factors that influence the effective teaching of CP in the curriculum.

Approximately 100 teachers participated in this study of secondary schools in in the west midland's region, which used quantitative and qualitative approaches within the same timeframe and giving each equal weight. The study used investigative research tools such as questionnaires and interviews. For statistical analysis, SPPS and ANOVA software was used.

Finally, this paper identifies the main challenges facing the implementation of the teaching of CP: lack of resources, time, support, programming experience and confidence. It found that many teachers do not have a link with academics researching the education of programming. The study found that lack of subject knowledge is one of the main challenges. Subject knowledge is vital in order to enable teachers to feel confident about teaching programming. It is important to offer support and opportunities for professional development for those presently charged with teaching CP in schools (Moller and Powell, 2019).

Keywords: Computer programming, National Curriculum, key stage 4 secondary school, challenge and problems, teaching and learning.

Developing a Self-organised Smart Production line for an IoT enabled Electroplating Process Plant

Navya Venkateshaiah, Ahmad Zakeri, Keith Burnham and Oliver Iliev

Abstract—In an Electroplating Process Plant the achievement of a desired quality in electroplating products requires continuous maintenance of the optimum condition of process solution in the process tanks along the production line. Parameters such as current density, solution temperature, agitation system, bath pH, bath concentration and plating time are known to have important role in determining the quality of the plating products and the productivity of the plating process plant. This paper presents the works being carried out by the authors in developing smart sensors and smart actuators for measurement and control of values of these parameters, and use of these smart devices for transforming the process tanks into smart tank stations capable of self-organizing themselves, i.e., being capable of self-monitoring the condition of process solution along the line and maintaining the desired process solution condition for achieving specific quality in plating products. The paper explains the methods used to install the smart devices in or around the tank stations and the use being made of ThingSpeak in developing smart tank stations. Previous work by the authors on use of IoT technology in Electroplating plant facilitated real time monitoring and control of the plant process from anywhere any time. This work further enhances digitalisation of the industry, paves thae way for achievemnt of an Industry 4.0 strategy in this Electroplating Industry.

Keywords: IoT, Cloud Service, Electroplating, and ThingSpeak

Deep Kalman Filter and Sensor fusion approach to the estimation of UAV's Attitude.

Kyaw Min Naing, Ahmad Zakeri, Keith Burnham and Oliver Iliev

Abstract: Unmanned Aerial Vehicle (UAV) needs to continuously estimate its position for carrying out a safe and successful autonomous indoor flight operation. The estimation of UAV's Attitude obtained through using Global Positioning Unit (GPS) may often be unreliable due to the possibility of surrounding high-rise buildings blocking the satellite signals transmitted from earth orbits. This paper establishes that a more reliable estimation of the UAV's attitude can be achieved through using the UAV's on-board sensors such as the Inertial Measurement Unit (IMU) sensor and the obstacle avoiding sensors. The approach developed by the authors localizes the UAV position through fusing the UAV's on-board (IMU) sensor and the obstacle avoiding sensors to eliminate sensor noise to obtain better estimate of the UAV's attitude from the raw data unstable outputs. The methodology involves use of deep Kalman filter with sensor fusion algorithm and sensor noise cancellation algorithm. Deep Kalman filter is an improved version of Kalman filter and Extended Kalman filter which uses deep learning techniques for faster prediction. The results achieved from testing on various indoor flight trajectories proved the approach presented in this paper is better in localization and the estimation of the attitude of UAV than the approaches that use GPS.

Keywords: Attitude estimation, Kalman Filter, UAV Localization, Indoor Localization, Sensor Fusion

Wireless Energy transfer to long distance flying Intelligent Unmanned Aerial Vehicles (UAVs) using reactive power transfer techniques

Kyaw Min Naing, Ahmad Zakeri, Keith Burnham and Oliver Iliev

Abstract Wireless power Transfer (RWPT) to Unmanned Aerial Vehicles (UAVs) is promising to be a ground-breaking technique for efficient charging of long-distance flying UAVs. WPT allows the power to be transferred directly from the ground station to a long-distance flying UAV eliminating the need for UAVs to carry heavy weight batteries as a source of power that adversely affect duration of their flight. This paper first reviews the recent application of Wireless Power Transfer to UAVs and highlights advantages of using this technique for economic and efficient design of intelligent autonomous long-distance flying UAVs. The paper then discusses the need for fusion of the sensors used in WPT and IMU sensors used in UAVs, the use of deep learning algorithm in long distance flying UAVs, and the factors that affect the safety and reliability of long distance power transfer to UAVs. The work described in this paper is part of the authors' research project that aims to investigate and develop sustainable autonomous unmanned aerial vehicles. The progress being made so far in implementing Reactive wireless power transfer techniques (RWPT), the potential future works, and the envisaged associated challenges are reported in this paper.

Keywords: Unmanned Aerial Vehicle (UAV), Wireless Power Transfer technique (WPT), Drone, Energy, Autonomous System, Sensor-fusion; Reactive wireless power transfer techniques (RWPT)

A systematic review of cloud computing adoption: an organisational perspective

Mahmud Maina Lawan, Chike Oduoza and Kevan Buckley

Abstract

Background: Cloud computing is a technology that offers several benefits to organisations such as cost reduction, scalability and flexibility, etc. Some studies have investigated the factors that influence adoption of the technology using different theories.

Aim: In an attempt to consolidate literature, this paper systematically reviews factors affecting cloud computing adoption by organisations.

Method: A search of related articles was conducted in different databases and further refined. A total of 37 articles was considered for this study. Salient factors were identified based on their frequencies.

Results: The findings showed that top management support, technology readiness, relative advantage, competitive pressure, complexity, compatibility and security are the most influential factors for cloud computing adoption by organisations. Also, the technology organisation environment (TOE) framework is the most applied theory, with most studies conducted in the SME sector. Also, majority of the studies used quantitate method.

Conclusion: This review consolidates literature and can benefit decision makers in organisations who intend to adopt cloud computing technology.

Keywords: Cloud computing, adoption, TOE.

Link to UNSDG: An interesting concept of cloud technology is that it can help organisations make operations greener. This can be achieved by eliminating huge data centres to reduce energy consumption. The cloud offers virtualization which helps increase server efficiency by up to 80%. The amount of energy consumed by a server is the same no matter the rate of utilisation; therefore, so much energy can be saved through higher efficiency. In addition, replacing on premise data centres by virtual data centres can help minimise carbon footprint. Applying virtualization to substitute 50 servers is equivalent of planting 450 trees. This is relevant to the United Nations sustainable development goals.

Investigation of ‘Smart Cities’ strategies within the United Kingdom

Sina Keshvardoost, Subashini Suresh and Suresh Renukappa

Abstract

Background: The Smart Cities Mission is an innovative and new initiative by the governments to drive economic growth and improve the quality of life of people by enabling local development and utilizing technology as a means to create smart outcomes for citizens.

The main purpose of research is to explore how smart governance and smart strategy developments are the key factors when considering the successful implementation of smart cities strategies. Smart cities create an extensive variety of issues and challenges that often poorly organised to deal with by their respective governments as they grow in size and complexity.

Therefore, the objective is to promote cities that provide core infrastructure on the basis of smart governance and sustainable development to improve the quality of life.

This research explores through a systematic review of the key challenges and issues that governance of smart cities is facing on this network performance by focusing on the governance models, with a particular interest on how these can contribute to successful smart city governance framework.

This research concludes that although there are considerable smart city dossiers in literature, their governance model and structural variations development across regions is lacking. (Meijer and Bolívar, 2016) Therefore, Future work will focus on collecting data from smart cities projects and organisations through semi-structures interviews and questionnaires within the United Kingdom and more in-depth exploration of governance issues and challenges of smart cities.

Aims: The aims of this research is to explore the concept of smart cities, the policy development in context of smart cities, to investigate and analyse the Governance frameworks for smart cities, to explore the issues and challenges within smart cities governance, and also the Security and privacy challenges related to smart cities

governance. And finally, to develop and evaluate strategic smart cities governance framework.

Methods: The Proposed methodology is based on the systematic literature review and use of qualitative and quantitative research.

Conclusions and Results: More in-depth exploration of governance issues and challenges of smart cities.

Future work will focus on collecting data from smart cities projects and organisations through semi-structures interviews and questionnaires within the United Kingdom.

Keywords: Sustainable cities, Smart cities, Governance issues, Smart Cities Challenges

Analysis of the Behaviour, and Optimisation of High-Strength, High-Precision Bonded Inserts within CFRP Structures

George Dye and Klaudio Bari

Abstract: Carbon fibre components and structures have become ubiquitous in the last few decades within the motorsport, aerospace and defence sectors, and are becoming more common in consumer grade products. However, very few products are made entirely of CFRP, and often products are mixed assemblies of CFRP and varied other material components. As such it becomes necessary to be able to reliable, accurately and strongly bond CFRP components to other materials and assemblies. In some cases, it is possible to simply use permanent fixing methods, such as adhesives to bond components, however, in many applications, the components must be securely bonded together, whilst being easy to disassemble. For example, the front wing on an open-wheeled racing car must securely and accurately attached to the nose cone as the car, as during operation it experience a huge amount to load. If it is not attached accurately the downforce and drag will act in an unbalanced way causing the car to have sub-optimal performance at best or be dangerously un-driveable at worst.

Due to the nature of CFRP as a material, it is not possible to just cut threads into a CFRP component, as this would damage the woven fibres, compromising the structural integrity of the component as whole. A common solution is to use threaded metal inserts, which are bonded post-cure into the CFRP structure, however this still requires cutting of the fibres, and, currently, there is no real methodology behind how this is done. Manufacturers merely drill the hole, bond in the insert and then cover it with several extra layers of Carbon Fibre, assuming that it will be strong enough.

This method will often result in an insert that will pull out of the material, before the threads within the insert pull-out. This is not a desirable outcome, as it is far easier and cheaper to repair threads in an insert, than repair or replace a full CFRP component.

This paper aims to analyse the failure mode of this method and compare it to inserts that are bonded into the structure during its construction, and then optimise the design of the insert and layup procedure to produce the optimal combination

This process will be conducted using destructive and non-destructive testing, as well as simulation work to produce a large pool of data that will be used to construct a mathematical model that will explain the behaviour of this kind of insert, and can be used to predict and optimise the performance of varied insert design and CFRP layup methods.

Keywords: CFRP; Threaded Inserts; Non-destructive testing; composites

Driver's Challenges: An Investigation into the Causes of Road Tanker Accidents in Nigeria

Augustine Odogun and Panos Georgakis

Abstract: Tanker drivers play an important role in the downstream oil and gas sector by ensuring that petroleum products are transported from loading depots to different retail stations in the country. However, the challenges faced by tanker drivers during the transportation and distribution of petroleum products have not been given adequate attention by many researchers in the field of hazardous material transportation. To this end, a study was carried out to investigate the challenges faced by tanker drivers during the transportation and distribution of petroleum products in Nigeria in order to explore solutions to minimise road accidents. The aim of this study is therefore to investigate the causes of accidents involving tankers purely from the driver's perspective. During the study, primary data were obtained through the systematic administration of questionnaires to tanker drivers at an oil loading depot in Nigeria. Both descriptive and inferential statistics were used to analyse the data obtained from the survey. The findings from the survey shows the importance of safety technologies, drivers training, risk management and transport regulations as possible ways to minimise accidents during the transportation and distribution of petroleum products in Nigeria. This study will be of benefit to the transporters of hazardous materials and will also help to reduce disaster risks posed by tankers during the transportation of flammable substances on the road in line with the Sustainable Development Goals (SDG) for disaster risk reduction (DRR) for social, economic and future development.

Keywords: petroleum products, environment, transportation, road tankers, risk management.

Link to UNSDG:

Automation Strategy from Unmanned Aerial System perspective in the Construction Industry

Hamlet David Reynoso Vanderhorst, Subashini Suresh, Suresh Renukappa, David Heesom and Keith Burnham

Abstract: Over the last 5 years, the use of Unmanned Aerial Systems (UAS) or Drones has increased substantially within the built environment sector. Construction organizations, governments, and non-profit organizations have established a range of use cases to exploit the ability to of drones to capture and share data including visual images, thermal data and chemical and radiation information. This information can then be stored in the cloud for ubiquitous access. Some of the key benefits of drone implementation centres on human risk avoidance, time reduction and the ability to support construction execution strategies through the use of digital data. Through the use of drone technology, the ability to perform a new style of vertical and horizontal construction monitoring provides construction teams with baseline data which can be used to underpin the development of digital twins. Furthermore, it provides the ability to continually capture digital data of the built environment, support mitigation risk plans and develop appreciation of hazards in an emergency. This is particularly true for developing countries such as the Dominican Republic. As the move towards Industry 4.0 gains traction, the application of drones for a range of operations in the construction sector is becoming apparent, however, at the present time there is still a need to define the potential role of drones in the sector beyond current applications.

Aim

With the above in mind, the aim of this research is to address the gap in knowledge relating to the use of drone technology within the construction sector to support the automation of a range of systems.

Method

A pragmatic, inductive, action research approach is being implemented. Through a mixed-method cross-sectional approach, data is being gathered to understand the beliefs, acceptance, reliability, and practicability of drone implementation for vertical and horizontal construction. Based on the gathered data, a thematic, content and

behaviour analysis is used for the qualitative approach. Building on the results, an experiment case is developed.

Result

Major findings to date highlight the political acceptance of the 4th industrial revolution within the Dominican Republican. Furthermore, it demonstrates the lack of technical knowledge is hampering an intelligent automation execution strategy through drone usage. Another finding demonstrates issues around taxation around the import of drone technology restrains its widespread diffusion (up to 52% in the purchase value may be tax).

Findings also highlight the optical sensors and software related to drone usage are being used to automate a range of applications of the built environment. Drones are used for capturing the site state, surveying, and generating 3D models. Supporting the findings of the literature review, results confirm the application of drones to support flood damage quantification, bridge inspection, dispute resolution in land affairs and construction cost-scheduling. Finally, the results highlight the potential of drones to integrate with other technological developments such as the Internet of Things and artificial intelligence.

Conclusion

In conclusion, this research demonstrates the potential of drones to support the 4th industrial revolution within the construction sector. Applications such as automated aerial paths and the use in the development of a digital twin for both individual buildings and larger urban areas, could also be used for simulation of worst-case scenario as emergency in developing countries.

Keywords: Automation, Digital Twin, BIM, Drone, UAV, Disaster Management.

Link to UNSDG: Increase Industry, Innovation, and Infrastructure and Improve Clean Water and Sanitation

A novel strain sensing mechanism in fatigue test of carbon fibre composite using Fibre

Shahzaib Azam and Klaudio Bari

Abstract

Background: Recent advances in materials science have resulted in a proliferation of flexible structures for high-performance mechanical, and aerospace applications (Sante, 2015). Large aspect-ratio aircraft wings, composite wind turbine blades, and suspension bridges are all designed to meet critical performance targets while adapting to dynamic loading conditions (Andrea, et al., 2001). By monitoring the distributed shape of a flexible component, fibre optic shape sensing technology has the potential to provide valuable data during design, testing, and operation of these smart structures. Fibre Bragg grating (FBG) have proved to be a potentially excellent technique for real-time *in-situ* monitoring of structures due to their numerous advantages, such as immunity to electromagnetic interference, small size, light weight, durability, and high bandwidth, which allows the sensors to operate in the same system, and the possibility to be embedded within the material (Evan M, et al., 2012).

Overall the introduction of an embedded fibre optic strain sensing system to composite structures is enhancing their use and leading to a wider range of applications, especially in the aerospace where 50% of the structural components are made of carbon laminate composite materials rather than conventional aluminium alloys (Sante, 2015). However, it readily suffers from the corrosion damage, fatigue damage, and their coupled effects. Thus, structural health monitoring is important for ensuring the integrity and safety of the component (Yanliang, et al., 2019).

Aims: Fibre Bragg Gratings (FBG) can be used to detect a number of relevant measureable parameters such as flow, degree of cure, strain, deformation and temperature. However, in Polymer-matrix composites (PMCs), when optical fibre and its fibre Bragg grating sensor is embedded in the composite lamina, the overall

fatigue strength reduction occurs (Lau, 2014). Using the FBG stain sensors, the overall aims are:

a) Detection of delamination, stain and its coupled effects, which is the most important damage for structural design of composite laminates

b) When the stain senor is clamped, during the lifecycle of the composite it is going to slip and it is one of a bigger problem in carbon fibre composite

c) To avoid signal loss in the case of fibre breakage, and maintainability to permit the replacement of damaged fibre sensors.

Method: The Structural Health Monitoring systems offer the possibility of monitoring the presence, size and progression of small impact damage (currently in the order of millimetres) in real time, in flight (Schubel, et al., 2012). A new damage detection system is going to be developed using a FBG sensor and the structure integrity will be investigated using ultrasonic sensing. Another method that is going to be used for the fatigue testing is the detection of Lamb waves in a CFRP laminate by FBG sensors using the high-speed optical wavelength interrogation system (Nobuo, et al., 2005).

In order to understand the damage tolerance time dependant during applying a compression, tension and bending stress on the FBG, the specimen will be mounted on an insitu testing stage that scanned using X-ray tomography. Using dynamic monitoring and well distributed FBG sensors across the specimen, a better understanding of the strain measurement can be obtained, hence lead to the less processing time and cost effective manufacturing (Yanliang, et al., 2019)

An Investigative Study of Micro-organisms associated with Heritage Buildings for a HBIM Framework within Refurbishment

John Peter Cooney, David Oloke and Louis Gyoh

Abstract

Background - Owing to the role that micro-organisms play, it can be seen that the need to comprehend the composition and functionality of complex microbial groups, within ancient structures is important as to ascertain if it is dangerous to health. This research aims to demonstrate the possibility of showing this within a process of demolition and refurbishment on a heritage building information modelling platform.

Purpose - Little or no application exists regarding the implication or recording of health and safety information, (especially legislation), primarily aimed at ancient structures, specifically at designated areas of demolition and refurbishment, particularly considering the inclusion of the identification of micro-organisms, which have adapted to varying environmental conditions throughout time.

Aims - The production of a prototype working HBIM (Historical Building Information Modelling) model to identify micro-organisms found within an ancient monument or otherwise; to produce a full analysis within a platform that informs the stakeholder of the micro-organism communities present; its analysis; to highlight results and portray a document management system within a HBIM platform to indicate and create health & safety legislation required, or sought, within the refurbishment sector, by means of Act of Parliament.

Method - Initial collection of specimens from site will be analysed using a PCR, Polyremase Chain Reaction), to extract DNA as to determine the Genus within the community. All results will be portrayed within a HBIM model and data management system to ascertain the required Health and Safety legislation is required for refurbishment within this or a similar site.

Results – Experiments from the case study will conclude to what data collection procedure would be more adaptable or suitable for the research, to give evidence and realisation seen from a HBIM precedent. Metagenomic analysis would satisfy a collection and creation of multiple datasets, however PCR would be required initially

to amplify DNA. The research would have a significant impetus within construction, heritage and the refurbishment of old and ancient monuments.

Conclusion - This initial process of the data collection method used, particularly within the metagenomic application, will create a standardisation and availability for such data from ancient monuments, hence to make available all data stored as such analysis becomes substantially important to enable the production of datasets for comparison.

Keywords – DNA, HBIM, Micro-organism, Metagenomics, Polyremase Chain Reaction.

Link to UNSDG: https://sustainabledevelopment.un.org/?menu=1300

Mechanical performance of Additively manufactured Aluminium Auxetic Structures

Manpreet Singh and Arun Arjunan

Abstract: Additive manufacturing (AM) or 3D printing is increasingly being acknowledged for its potential to support sustainable design. In this regard, the potential of AM to create highly complex metallic structures at the micron-level that can exhibit auxetic behaviour is of significant interest. The auxetic behaviour is non-traditional and allows for superior mechanical and energy absorption capabilities, which will be explored in this research. The focus will be primarily on the influence of design parameters such as thickness (t) and auxetic angle (ɵ) on mechanical performance of additively manufactured auxetic lattices. AM is revolutionary in this aspect: there are two fundamental aspects that define sustainable manufacturing: the actual manufacturing process and the impact of the product produced. Even though AM has significant effects at both levels; the research is focused on the second aspect which is the impact of complex parts produced. Following the critical review of literature, the research aims to design and study the mechanical performance of a new class of negative Poisson's ratio structures called "hierarchical auxetic Structures". Hierarchical structures allow for high porosity while offering promise for light weight applications. The output of this research will aid in the development of lightweight auxetic structures for various structural applications. The current research project contributes towards achieving the United Nation's Sustainable Development Goals (SDG) 9, 12 and 13.

Keywords: Additive manufacturing; Auxetic Structures; Aluminium; Hierarchical design; Mechanical performance

Link to UNSDG: 9, 12 and 13

Formative assessment tools for supporting learning of introductory computer programming in universities

Marwa Alghodi, Kevan Buckley and John Kanyaru,

Abstract

Background: The assessment in the high education is divided in two parts: summative and formative assessment (FA), there are valid reasons for promoting learning through the development of FA tools, especially in computer science. Learning and teaching of computer programming languages can be very challenging. For this reason, teachers need to conduct assessment procedures during the process of learning in order to modify learning and teaching activities to improve learners' performance.

Aims: This paper aims to identify the relevant details of FA such as the structure, types and contents as well as studies the pedagogy of it. It further discusses the components, architecture and the factors that exist in online formative assessment.

Methods: Related studies was searched and refined to conclude the main factors of the FA in general, what are the challenges of learning programming languages and what are the FA tools that we use nowadays to learn programming languages?

Result: All researches confirmed that using FA in the learning process is very useful to improve the students' performance, provided that applying it the right way and achieving all its goals.

Conclusions: This study combines literature that explains the role of the pedagogy in FA and identifies the main components of it, also encourages the education institutions for adopting FA in their education process. This review explored the development of FA tools from different perspectives. While it is difficult to assume any easy adaptation of FA tools for learners and development, this study, in some extend showed the potential of FA to immensely contribute to the processes of learning of introductory computer programming language that is the focus of this study.

Keywords: formative assessment, high education, programming.

The enablers and techniques for managing stakeholders within BIM-implemented projects

Sukhtaj Singh, Ezekiel Chinyio and Subashini Suresh

Abstract: In the last decade, the construction industry has witnessed a major increase in the use of Building Information Modelling (BIM), which added new challenges to an already complex process of construction. Project managers are now facing greater challenges of managing stakeholders within BIM-implemented projects. Therefore, this paper uses primary data to discuss the enablers and techniques of managing stakeholders effectively within BIM-implemented projects. The primary data were collected through 23 semi-structured interviews conducted in the UK. The purposive and snowball sampling techniques facilitated these interviews while the resultant data were analysed by 'content analysis' and by using the NVivo 11 Pro software. The findings revealed that learning experience, holding meetings and online collaboration and creating a sharing and learning environment were the top techniques used by organisations for managing stakeholders. The paper concludes that organisations should train their staff and encourage informal communication among them. Mentoring should be encouraged and supported by top management.

Keywords: building information modelling, enablers, project managers, stakeholder management, techniques

Link to UNSDG: Sustainable Development Goal 9, i.e. build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation.

Improving the tableting properties of paracetamol by milling – Effect of milling time

Hamisu Hamisu M and Waseem Kaialy

Abstract: Commercially, tablets accounts for over 80% of all dosage forms. However, for most drugs it is difficult to compress powders alone into tablets due to their poor flowability and compactibility. Paracetamol is drug that exhibits poor compactibility resulting in fragile tablets with high capping tendency during tabletting. Although the drug is usually granulated with binders and diluents to enhance its compactibility, granulation methods demonstrate multiple disadvantages, such as being expensive, time-consuming and stability concerns for drugs which are sensitive to heat and moisture. Milling is an important unit operation employed in the pharmaceutical industry for the production of pharmaceuticals in a reduced size. Milling is a process that does not involve the use of solvents, appropriate for batch operation and provides the opportunity to control the size of the milled product.

With the vision towards sustainable developmental goals of ensuring healthy lives, improving quality medications will significantly play a vital role in promoting good health and well-being of millions of people. The aim of this study was to investigate the effect of milling time on the physicochemical and mechanical properties of monoclinic paracetamol, with a view to enhance its poor mechanical properties. To this end, formulations containing paracetamol polyvinylpyrollidone (binder), $_{L}$-leucine (lubricant), and Primojel® (disintegrant) were milled using (Fritsch pulverisette 6, Germany) mill at rotational speed of 400 rpm at different milling times (1, 5, 10, 15 and 20 min). The resultant powders were characterised for their particle size, shape, solid-state, flow and tableting properties.

The results showed all the milled formulations to have significantly improved tableting properties at various compression pressures from 37 to 222 MPa as compared to commercial Paracetamol and the physical mixture. The tableting properties of the prepared formulations were dependant on milling time.

Interestingly, the tensile strength of tablets showed a linear increase with milling time from 1 min to 15 min, after which extensive milling for 20 min caused a decrease in tablet tensile strength. Solid-state analyses confirmed that the improved tableting properties was due to an increased level of hydrogen bonding between

polyvinylpyrollidone and paracetamol in the case of the milled formulations compared to the physical mixture formulation. Additionally, powder X-Ray diffraction analyses showed that the relative crystallinity of the milled formulations to slightly decrease with increasing milling time.

In conclusion, good quality tablets of a challenging model poorly compactible drug, paracetamol, can be prepared via milling with selected excipients. Milling time is a vital parameter during processing as it alters the physicochemical properties of the prepared formulations and an optimum milling time needs to be determined. Further studies will focus on improving flowability of milled mixtures by investigating the effect of using various glidants.

Adoption of smart healthcare management strategies from a smart cities perspective

Primrose Mudiyi, Suresh Renukappa and Subashini Suresh

Abstract: Presently, the United Kingdom (UK) and the rest of the world are seeing an unprecedented change in demographics thus, a growing and an aging population. According to the King's Fund (2019) the population in England alone has risen by 10% from 2003 to 2015 and the number of people aged over 85 has risen by 40% during the same period. A growing and aging population is positively related to chronic and long term complex illnesses requiring increased usage of healthcare resources (Kruse et al., 2018). Additionally, it is a global agenda to ensure everyone lives a healthy life thus, there is greater need than ever for the healthcare sector and governments not only need to deal with the current increase in demand on services but also ensure a future proof solution that allows people to independently manage their health and well-being to live quality healthy lives. The aim of this research is to develop and validate a strategic management framework that seeks to act as a guideline to successfully adopt smart healthcare strategies within the UK healthcare sector. Data is collected through interviews of healthcare professionals, healthcare managers, healthcare IT managers and healthcare IT employees. This research enables healthcare policy makers and managers to understand the link between smart healthcare management strategies and local, national and international strategies and also to understand the impact of adopting smart healthcare management strategies on individual healthcare practitioners, healthcare organisations' processes and procedures and healthcare policies.

Keywords: Smart healthcare, telehealth, mobile healthcare, Health Information Systems (HIS)

Link to UNSDG: UN Sustainable Development Goal 3- Good Health and well-being

With a growing and aging population it is essential to ensure healthy lives and promote well-being for all at all ages. To promote healthy lives and well-being, the adoption and use of smart healthcare management strategies such as telehealth and mobile health provides numerous means and ways to ensure healthcare is provided to everyone anywhere in a fast, efficient and sustainable manner. Smart healthcare strategies are enablers of improved healthcare, increased life expectancy and universal healthcare coverage which provides quality, safe and positive healthcare outcomes for everyone guaranteeing the delivery of Sustainable Development Goal 3.

Addressing environmental issues in the oil and gas industry: Nigeria as a case study

Odeyemi Olayinka, David Oloke and Chike Oduoza

Abstract: Our environment is being endangered day-by-day due to environmental pollution across the globe. Currently, five million environmental deaths are recorded each year. These attributes to nine percent of the deaths globally. However, historical record of oil spills environmental pollution since 1970 shows a wide range between 7-700 tonnes per year, which goes against Sustainable Development Goals (SDGS). Through unsuitable management, a deficit of integrating the workforce has inspired the environmental challenges in many countries. Meanwhile, adequate efforts are required globally in section three/eleven of SDGS to tackle the determinants of health and antimicrobial resistance such as air pollution, sanitation, deaths and inadequate environment. Insufficient data and mismanagement have also improved enormous risks and trails in the oil and gas (O&G) sectors. Such challenges include gas flare, pipeline leakage; spills, explosions, accidents, human error and others. The evidence further suggests that there is immeasurable menace in terms of financial, environmental, health and safety (EH&S) implications, predominantly in developing countries such as Nigeria. According to the literature-review and preliminary study outcome, failure of the Nigeria EH&S management system and the Nigerian government in this regard appears to be the main gap that induces environmental problems in the country. Also contributing are the issues of lack proper project supervision and insufficient attention given to outdated laws, current laws, human rights, corruption and managerial of O&G manufacturing industries. These are contrary to the expectations of the section eleven of SDGS, which seek to make human settlements (including the communities and cities) safe, resilient and sustainable.

Previous research has shown that environmental management systems (EMS) and health and safety (H&S) management systems are existing in isolation, a process which had only partially addressed the issues. However, units three and eleven (3&11) of SDGS call for appropriate management, good government and sustainable projects across the globe. Evidences from literature show that integrating environmental, health and safety management system (E, H&SMS) in O&G industry has a potential to improve the environmental performance strategies and

functionality of the O&G managerial sector in Nigeria. However, section three of SDGS notes that promotion of well-being and ensuring healthy lives for all at all ages are paramount. This research, therefore, seeks to provide a framework that incorporates both environmental and, health and safety management systems for managing environmental degradation in the oil and gas industry, using Nigeria as a case study.

It is proposed that a mixed-method approach is used to develop and validate this framework as a precursor to the development. This would involve the preliminary study, questionnaire administration and interview of key experts and practitioners in the field. It is thus envisaged that the data collected and analysed will underpin the propose development.

Keywords: environmental, management, oil and gas, health and safety

Adoption of selective laser melting for the development of Cobalt-Chromium-Molybdenum functional auxetic bone scaffold

Chameekara Tharumal Wanniarachchi and Arun Arjunan

Abstract: Auxetic structures are unusual architectures that show unconventional strain behaviour resulting in negative Poisson's ratio. In doing so, these structures exhibit deformation modes and mechanical characteristics that are different from traditional porous architecture. This can lead to favourable outcomes for load bearing tissue engineering applications; which, this research is aiming to exploit. As a first step, this paper presents an overview of the latest advances in the area of metal additive manufacturing and auxetic tissue engineering. Primary attention has been on identifying the trends in biomedical auxetic structures along with their mechanical performance. Following the critical review of literature, Cobalt-chromiummolybdenum (CoCrMo) has been chosen as the biomaterial of choice as a result of its high elastic modulus (210-250GPa) and density (8.4 gcm-3) leading to superior stiffness performance. This in turn allow for significant opportunity to develop porous auxetic structures that can reduce stress-shielding effects associated with highly stiff implants. With this aim, the research investigates the suitability of CoCrMo porous auxetic designs that allows for functional bone scaffold featuring the mechanical properties of the host bone. The literature review found that auxetic structures show unique properties in comparison to conventional porous structures in elastic strain, indentation resistance, shear modulus and fracture toughness. This can subsequently help develop functional CoCrMo auxetic bone scaffolds to mimic the mechanical behaviour of the host bone while reducing stress-shielding and maladaptation. In doing so, this research adds to the state-of-the-art in patient-specific implant design thus accelerating post-surgery recovery. This in turns contribute to the united nations sustainable development goals 31 and 92.

Keywords: Auxetic structures, Negative poison's ratio, Additive Manufacturing, Biomaterials, Design and modelling

Link to UNSDG: 3, 9

Evaluating drivers for implementing sustainability strategies within the Qatar oil and gas industry: Multi-theory approach

Redouane Sarrakh, Suresh Renukappa and Subashini Suresh

Abstract: With the increasing importance given to sustainability, organisations now-a-days are implementing sustainability practice within their strategies to ensure a positive impact on their stakeholders, society and environment. The Qatar oil and gas industry and following the implementation of Qatar National Vision 2030 decided to adapt sustainability initiatives. However, the concept is still elusive for organisations within the industry. Furthermore, there is a very limited research on drivers for implementing sustainability practices within organisations within the Qatar oil and gas industry, which is the core purpose of this paper. The multi-theory approach (i.e. institutional theory and resource-based view of the firm) was used as the theoretical background to shed the light on external and internal pressures exerted by different contributors on organisations in order to implement sustainability practices. The qualitative research approach was adopted to collect and analyse data. The findings show that organisations within the Qatar oil and gas industry are driven to implement sustainability by eleven drivers, that could be grouped, with the help of the theoretical background, into internal and external drivers. Seven drivers were identified as external drivers and are grouped following the institutional theory framework into three main categories, coercive (Government regulations and laws), normative (NGOs pressure; Customers pressure; International environment standards; Suppliers pressure; Community pressure) and mimetic pressures (Competitive pressure). Four internal drivers were identified, leadership attitude, employees' attitude, reputation and shareholders attitude. Using the Total interpretive structural modelling approach, the causal relationship between the drivers is identified and it is found that the international environment standards, reputation and governmental regulations and laws are amongst the key factors that drive organisations within the Qatar oil and gas industry to implement sustainability strategies. While, NGOs and suppliers' pressures have the least driving powers for sustainability implementation. Therefore, decision makers and executives must have a better understanding of sustainability pressures exerted on their organisation in order to ensure an improved sustainability performance within the sector.

The effect of combined *trans*-cinnamaldehyde and eugenol on food pathogens in traditional African yoghurt

Betty A. Ogwaro, Hazel Gibson, Liz O'Gara and Dave J. Hill

Abstract: Traditional milk fermentation with incorporated herbs and spices has been practised since time immemorial in Africa to enhance the flavour and aroma along with increases in the shelf life of the acidic yoghurt. However, food poisoning and some pathogenic microorganisms such as *E. coli* 0157:H7*; Salmonella typhimurium* and *Listeria monocytogenes* have still been recovered in fermented milk such as yoghurt.

In these experiments, milk fermentation mimicking traditional African yoghurt processing was carried out incorporating selected herbs and spices during the milk fermentation. The aim of the experiment was to examine whether the herbs and spices have antibacterial activities individually or in combination against selected food pathogens.

A preliminary experiment was carried out by incorporating varied amounts of actual whole spices (cinnamon and cloves) in the fermenting milk and the growth of *Salmonella typhimurium* (UCC 73; 226), *Listeria monocytogenes* (UCC 508)*, Staphylococcus aureus* (UCC 77) and *Escherichia fergusonii* (UCC 585) was assessed along with monitoring the change in pH and titratable acidity over 144 hours. Subsequently, chemical compounds were extracted from these spices using steam distillation technique. The compounds were then characterised by NMR spectroscopy using the benchtop Spinsolve NMR spectrometer and confirmed by Gas Chromatography and Mass Spectrum (GCMS) to identify the different components which were recovered in comparison to pure essential oil extracts.

The antimicrobial activities of the essential oils of the spices (*trans*-cinnamaldehyde and eugenol) were assessed using the agar disc diffusion method, the Minimum Inhibitory Concentration (MIC), viable counts and Optical Density (ODs) measurements was carried out using the Bioscreen analyser. An assay was performed to determine which combinations have a synergistic effect and time-kill curves using the Bioscreen to further verify their bactericidal effect.

The results showed that all of the tested bacteria strains were sensitive to *trans*-cinnamaldehyde and eugenol and the combination of the two (*trans*-cinnamaldehyde with eugenol) showed good synergistic antibacterial effect against all of the four tested bacterial strains. In conclusion, these combinations of may serve as a promising natural food preservatives in yoghurt.

This research could be taken further by encapsulating the active ingredient of the spices and incorporating it in fermenting milk for slow but more effective antimicrobial function. This approach increases the stability of volatile components, reducing the strong aroma of the spices, protecting them from interacting with the food matrix, and increases the antimicrobial activity due to increased passive cellular uptake.

Key words: traditional African yoghurt, spices, natural food preservative, bactericidal, food pathogens

To develop a framework for a viable management of road construction and development scheme in South East Nigeria.

Emeka Luke Okolie, David Oloke and Emmanuel Daniel

Abstract

Background: The potential of the construction sector is exceptional as it can boost investment and provide the masses with employment opportunities. Also, Investment in Infrastructure are vital to achieving sustainable development in any country. About 93 billion dollars need to be expended yearly by Africa to bridge the gap of infrastructure requirements. In Nigeria's drive towards a viable economy and social stability, infrastructure development remains key and various administrations have adopted it as a major part of their policies, especially road construction. In Nigeria, the federal and state governments are responsible for most of the road projects at 64.5% and 22.7% respectively. The problem of road construction project abandonment has affected the economy of the South East (SE)states and Nigeria as a whole.

Aim: The aim of this study is to understand the causes of road construction abandonment and the effectiveness and efficiency of the existing framework for road construction in SE Nigeria. Therefore, a sustainable framework will improve road construction and management using Public Private Partnership (PPP) model.

Method: This is a qualitative research whereby the units of analysis are staff of state ministry of works in Enugu, Ebonyi, Anambra, Abia and Imo States, staff of registered construction companies engaged in road construction work within the region, investors, road users, and entrepreneurs within the case study area. Interviews and case file will be utilised for the various bodies mentioned above for the research method. An Effective and Efficient Road Construction(E^2RC) framework will be used to serve as a template for clients, contractors and investors to achieving a viable road construction and development scheme.

Result: As the Nigeria populace continues to demand for good road infrastructure, there is probability of higher rate of success in construction work with a management approach even though road construction is a highly technical field. The result so far from the study have identified corruption, inconsistency in government policy, poor

project planning and scheduling, poor project estimates and inadequate technical knowledge as key factors responsible for road construction abandonment.

Conclusion: There is consequence for Government funding majorly road projects in Nigeria, numerous agencies regulating and enforcement is poor. Therefore, this study will answer the research question which is, what procurement strategy could be employed to achieve the desired effectiveness and efficiency in road construction and management, especially in SE Nigeria? Thus, a modern sustainable PPP framework should address it and this study is gradually doing it.

Keywords: Project abandonment, Road infrastructure, Framework, Procurement Strategy, Public-Private Partnership.

Link to UNSDG: The general public should feel concern about sustainable development. They are entitled to a healthy and productive life in harmony with nature. Sustainable development needs this factors industry, innovation and infrastructure to meet its target in our communities. This is goal 9 of the UNSDG.

Managing knowledge in the context of smart cities

Wala Abdalla, Suresh Renukappa and Subashini Suresh

Abstract: Extensive urbanisation is increasing on a global scale. Many cities, due to rapid population growth, face two conflicting issues. On the one hand, problems include the overexploitation of resources, inadequate number of services, and an increase in pollution. On the other hand, sustainable goals must be achieved to overcome these challenges. The integration of new aspects brought to take into account innovative factors in governance and management of the urban areas, and this process turned the focus on more complex conceptualizations such as the "smart city", wherein human and social capital and traditional and modern communication infrastructures are combined to enhance sustainable economic growth and citizens' quality of life. The most recent view on smart city development has recognized that the level of technology adoption in urban contexts is no more able to reflect the real smartness of cities. Thus, technology no longer represents an end but becomes a component of smart cities. Accordingly, with the emergence of the knowledge economy, the development of smart cities is becoming more and more knowledge based. Therefore, knowledge is now conceived as the core component that makes cities smart. Nevertheless, the current literature on smart cities has mainly focused on technological advancement of a city's hard infrastructure systems rather than delving into the managerial dynamics and KM issues underlying the development of smart city initiatives. In-depth research on the development of smart cities from a managerial and KM perspective has remained scant. Therefore, the aim of this research is to investigate how the UK public and private organisations are managing knowledge in the context of smart cities. At the current stage of the research, the findings are in the main based on thorough review of literature findings. The main findings indicated that the deployment of ICT and city's hard infrastructure systems have been the primary concern of the current smart cities related research, and the extant research falls short of a clear understanding of KM in the context of smart cities. Managing smart cities related knowledge is a complex task requires appropriate managerial actions. KM governance and KM processes are the main issues to effective implementation of KM practices in SC projects. The knowledge needed for the development and prosecution of smart city projects can reside in various domains. The findings also indicated the various

challenges for managing smart cities related knowledge including; organisational issues, lack of time, trust, management support, and awareness of KM's importance, leadership, knowledge storage and transfer challenges. To conclude: SC is still relatively new concept in the management field. Managing SC projects is quite complicated and advanced process. The current research falls short of clear understanding of KM issues in the context of SC.

Keywords: smart cities, knowledge management, competitive advantage, knowledge economy, knowledge creation.

Link to UNSDG: Goal 11 of the Sustainable Development Goal(s): Sustainable Cities and Communities.

Thermal Cracking of solder joints in PV Module Interconnection

Alireza Eslami Majd and Nduka Nnamdi Ekere

Abstract: As the UNSDGs (United Nations Sustainable Development Goals) follow global strategies to solve many of the world's challenges, such as climate change and working to preserve our oceans and forests, the utilization of clean and renewable energy sources is becoming far more important. One of the fastest developing renewable energy sources is Solar Cell modules which can be available in most areas of the world. As the cost of PV (photovoltaic) solar panels drops, it is widely expected that solar energy will become the cheapest source of electricity in many parts of the world over the next two decades. To ensure that PV modules have a long service life and can meet the PV manufacturer's warranty, the PV modules need to have high reliability. A critical part of the solar PV module assembly is the interconnection strip between the solar cells, and failure of the interconnection strip can adversely affect the performance and reliability of whole PV module. Interconnection strip failures have been linked to the thermal cracks which are nucleated in the solder joint material during the high temperature manufacturing process; and then the crack will be propagated with the thermal cycling under higher than ambient temperature PV module operating conditions. This work reports on the study of high temperature crack nucleation and growth in different PV Module interconnection configurations by using XFEM in ABAQUS software. It concerns a necessary, urgent and fundamental revision of the soldering process that lies at the heart of PV module ribbon interconnection manufacture. The results of the study will also be useful for researchers in evaluating the impact of the solder region boundaries on solar PV module reliability and in developing design-for-reliability guidelines.

Keyword: PV Module Interconnection, Reliability, XFEM, Crack Nucleation and propagation, Thermo-mechanical Stress.

Understanding business models and delivering smart cities for developing countries

Nisha Shetty, Suresh Renukappa and Subashini Suresh

Abstract: Cities are a motive force in generating and maintaining world's economic growth accounting for 80% of the global GDP. Cities have always been the engines of development and changes in society. Smart technologies can help address the urban challenges and improve quality of life, economic opportunity, and liveability for citizens. Cities benefit from a transparent overview of best practice solutions to become smarter and from identifying best-suited solution providers. Companies that make cities smarter benefit from becoming more visible to cities around the globe with their newly developed or proven solutions. Innovative business models help accelerate the adoption of smart technologies. Business models provide significant revenue to smart city owners through internal efficiency, money, city infrastructure and value integration. Analysis of different business model stereotypes and archetypes for smart cities has developed an intangible agenda of research at the intersection of business models and smart cities. Innovative business model is at a very niche stage of research, it addresses the research gap in innovative business models for smart cities. It further investigates the management and organisational problems. A city encounters challenges in the planning, managing and operations phase. Overcoming these challenges with a developed business model provides an outcome with better interactions with citizens. The research provides answers to the research question on the challenges faced by smart cities to develop innovative business models. The research question aims to generate descriptive knowledge about the process organisations/governments undergo to move into new innovative business models for smart cities development. Decision makers, academy, business and citizens provide the augmented process for a business model operation.

Keywords: smart city, business model, innovative business model

Link to UNSDG: https://sustainabledevelopment.un.org/sdg11

Innovation aspects in sustainable business models: a conceptual framework

Martinez G, Suresh Renukappa and Subashini Suresh

Abstract: Business model innovation is a field that has gained a lot of attention in the recent years and is defined as the design of value creation, delivery and capture processes in an organization. With current pressures on our planet resources and the environment business model innovation give organisations a way to ensure that their operations create positive impact on the environment and society. Ideally a sustainable business model is one that contributes to sustainable development while ensuring competitive advantage by delivering greater forms of value to customers. The three core concepts in the business model definition (value proposition, value creation and delivery and value capture) were expanded with the theory of the business model canvas enabling the theoretical framework to understand the complexities derived from innovation of single elements of the business model. The present work aimed to prove the hypothesis that an innovation or transformation of an element of the business model lead to changes in other elements because they are strongly interconnected. But first, providing understanding of the concept of business model innovation and its drivers. Analysis of the literature reviewed proved the hypothesis that innovating even a single element of the business model result in impact of two or more elements. The relationships between these were mapped, based on the evidence found in literature. The relevance of this activity relies on the fact that developing an understanding of the effects of innovation on the elements of the business model helps organisations to plan and adjust accordingly to achieve the desired results.

Keywords: Business model, innovation, impacts, value creation.

Use of blockchain in public customized business and consumer plastic relationship responsibility efficiency enhancement

Otu, Abasifreke Ifreke and Kevan Buckley

Abstract: The thesis highlights, observes and seeks to detail the use of blockchain technology particularly the identity of plastics as the saturated use is tiringly overlooked as it is in our toothbrushes, phones, takeaway & delivery containers, disposable utensils and even remote TV controls (GreenBiz, 2020). Due to the enormity of the plastic use, the chosen pathway is restricted to the customized business to consumer product relationship to amply fit within the boundaries of the research time frame and consonance with Sarah Nelen (European Commission – waste policy directorate) resonating fact affirming that by 2030, a high percentage of packaging should be recyclable but more important is to look at material-specific targets with plastic packaging 'more problematic' to recover and recycle than cardboard boxes that are used by online shops (Euractiv, 2018).

Background: The stir in respect to the awareness of blockchain technology awakened a curiosity of acclimatizing the society with a better nous to aid improvements in adoption, collaboration, monetary saving and resource optimization. Hence a renewed innovative ethical profitable concerted focus is on the consumers by encouraging their participation in a decade new circular economy which seeks remedying focused activities in resource management from intensive usage to a more lasting extensive sharing of the same resource within an end to end loop cycle with special regard to customized business (food packages, plastic bottles and single-use shopping bags).

Aim: Creating a template (which in partnership will be a developed prototype of a blockchain program using python) which according to (Dustdar, 2016) has transformed the IT landscape for both individuals and enterprises from the way we access, store, and share information to how we communicate, collaborate, and process data for enhancing the responsibility of the 'business and customer' plastic relationship in the specified background above and where possible, a grafting to harness across in other areas within the plastic wide use if suited.

Method: With appropriation, this thesis conveys the thorough supervised sequence orderly arranged in tandem to the disciplined adherence to the research boundaries

and attributes of the field, subject, professional and ethical considerations. ‘C to C to C’ (Triple or C^3) was the procedure formulated to transport this research from ideology to actuality.

The first ‘C’ stands for concurrently while

The second ‘C’ stands for consecutively and

The third ‘C’ stands for composition;

With ‘to’ stands for the period of which the switch was necessary.

‘Concurrent’- meaning paralleling activities happening at the same period portraying the detailing (critical analysis of existing work and write-up of current pertaining applicable interests) and the development (tasks of template creation) at the same time while ‘Consecutive’ - meaning succeeding of a designated activity after another activity without an interlude portrays the detailing (matching documentation) observed during and after the development (specified milestone tasks) with ‘Composition’ - meaning summation of required parts to form a whole applicable entity portraying the completion of the research journey and finally, ‘to’ - as the inferred time of transition recognised after supervised analysis observation reckons so.

Methodology: Within the above appropriation, this thesis conveys the in-depth tapestry of and within the above formulated method. Beginning with ‘business’, ‘consumer’ and the ‘relationship’, diagrammatically below:

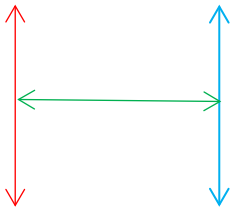

FIGURE 1: METHODOLOGY OF RESEARCH METHOD

Where the red line represents business, the blue line represents consumer and the green line represents the relationship (customized plastic product of the business purchased by the consumer) such as ‘ABC bottled water’.

Relative to the research is classed into two (detailing and development), requirements of each is identified, accessed, acquired, applied and critically reviewed; with their respective certain actions though with some overlaps. The detailing consisted of the research mould, structure formulations, refined relative brew of literature and an elastic allowance in accommodations, adaptations and abilities in formatting all of the inputs, processes and outputs to acclaimed standards. The development on the other hand entailed prototype of a blockchain, python programming language and other technical requirements.

Results: At this point of the research, findings drawn based upon the yield of the above method and methodology (detailing and development being implemented under supervision) suggest a higher focus is already on the reduction of plastic use but a relative weak or pedestrian consumer oriented participation fostering just as (Coke, 2019) embarked on a ‘feet on the street campaign’ deployment of its employees and workers to partake in informing residents on the requested and required waste targeted by their tagged bins due to unsolicited plastic refuse.

With addition to the technology (blockchain), the same format of appraisal can be drawn as its benefits is enriching courtesy of the UK financial sector reaping an employability uptake of employees and ten percent of its registered businesses surpassing a market threshold of hundred billion dollars in June of 2017 (Rt. Hon Matt Hancock MP, 2018). Nevertheless, the technology (blockchain) is still rough edged and not entirely smooth as the proclamations such as before may sound with challenges not fully catered for with an appointed resolution as (Jesse Yli-Huumo et al, 2016) inform pictorially below:

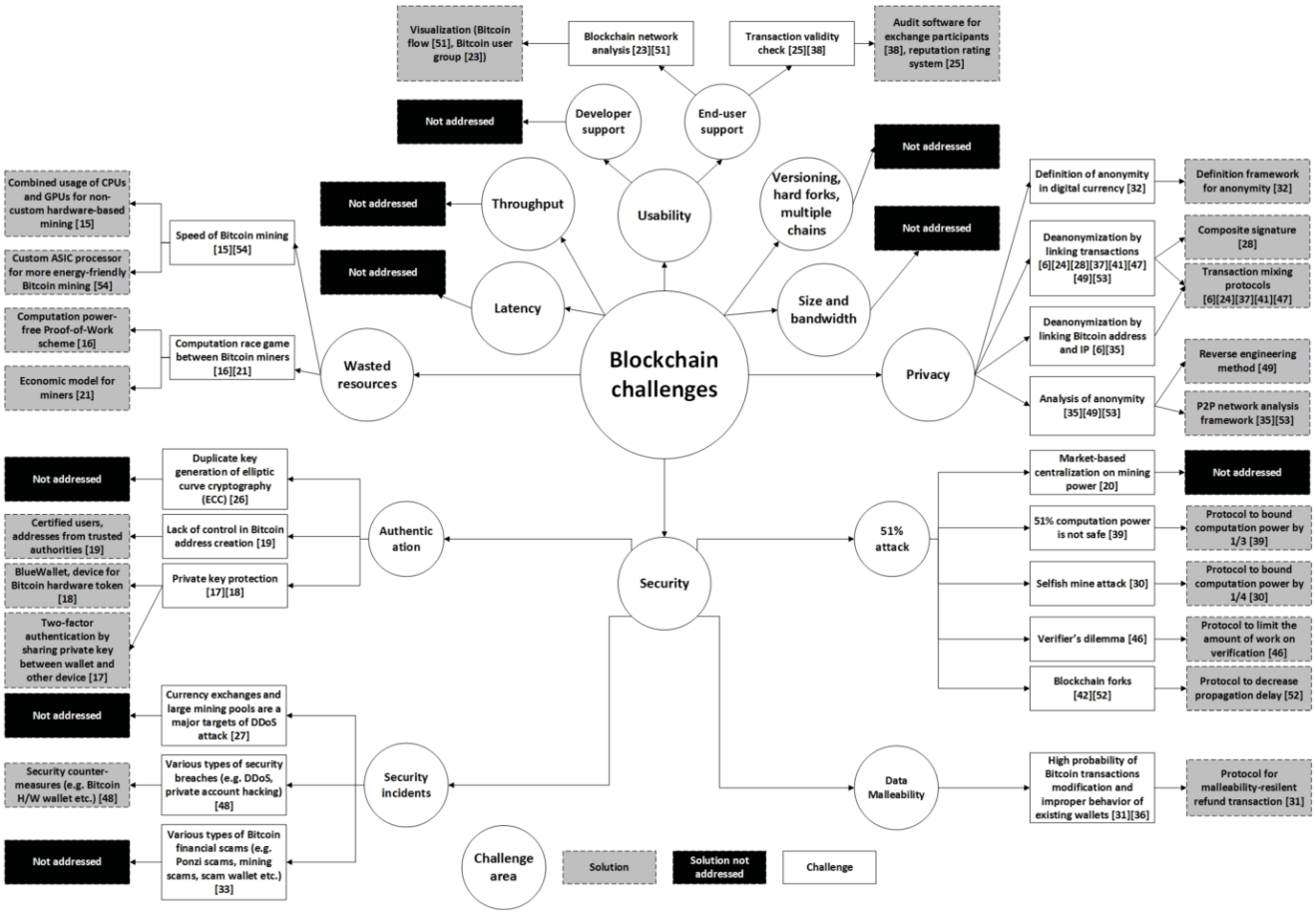

FIGURE 2: BLOCKCHAIN CHALLENGES

Thereby providing an in-depth yield of the above method and its inherent methodology with the findings considered anchoring the research in a recipe with 'blockchain technology' centrally within 'plastics' in relation (arrow lines) to the specified critical factors (rectangle blocks) all restrictively hinging on enhancing the relationship responsibility of businesses and consumers represented by the cyclic band diagrammatically interpreted below:

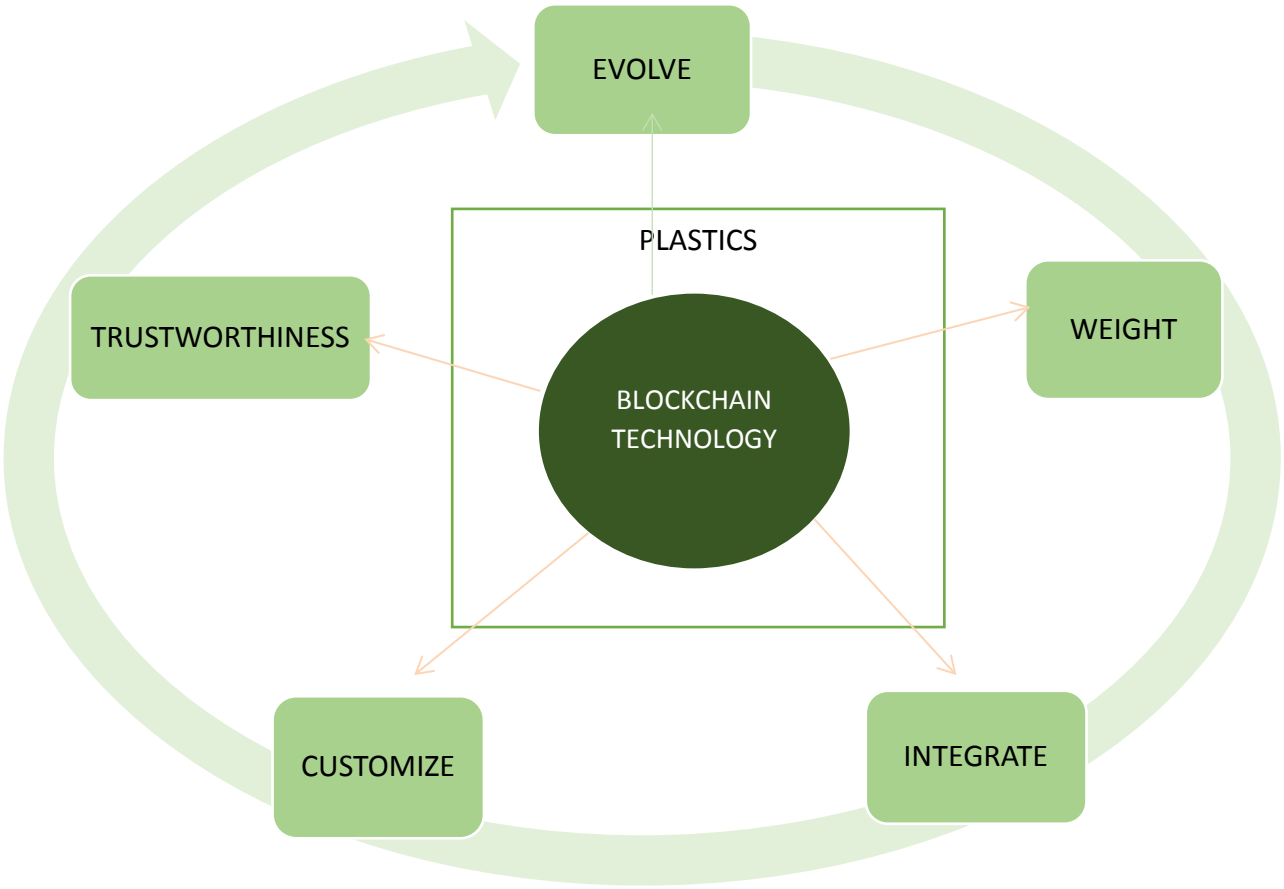

FIGURE 3: CURRENT RESEARCH RECIPE

Conclusions: “Amazon, International Paper and Starbucks Coffee Company have stepped up to the plate by dedicating dollars to create healthier communities through recycling” (Keefe Harrison - CEO of The Recycling Partnership, 2018). Clearly, there is an occurring theme that there is indeed an ongoing evolution with weight of plastic usage as the keen index of accounting as most businesses are pledging integration of this trend as a means of customizing their brand to project trustworthiness to the consumers and public at large.

With the projection of ‘QATAR 2022’ below:

FIGURE 4: FIFA WORLD CUP QATAR 2022 SUSTAINABILITY STRATEGY

As a sustainable strategy (FIFA, 2020), it is therefore imperative that harmonizing the above method and its inherent methodology (detailing and development being implemented under supervision) together with the findings, conclusions pointed out at this time of the ongoing research prescribe that the fostering of consumer oriented participation must not be a bait for their swindling but seismic co-operation and effective encouraging rewards with the yielded recipe as the engine vessel.

Keywords: BLOCKCHAIN: A coded secured chain of record blocks" (Conference: World Blockchain Summit 2018).

CIRCULAR ECONOMY: A sustainable approach in resource management by shifting from an intensive usage model to an extensive sharing model minimizing waste.

FIFA: Federation International of Football Associations

Link to UNSDG: Sustainable Development Goal 12 – Responsible Consumption and Production.

Link: https://sustainabledevelopment.un.org/sdg12

The role of Rnd3 in kidney morphogenesis and function

Kavindiya Modarage and Paraskevi Goggolidou

Abstract: Within the collection of 17 global goals designed for 2030 Agendas for Sustainable Development, the main developmental goals that are of primary focus to this investigation include Goal 3- To ensure healthy lives and promote well-being for all at all ages, Goal 5- To achieve gender equality and empower all women and girls and strengthen the means of implementation and Goal 17 – To revitalize the global partnership for sustainable development.

Polycystic kidney disease (PKD) is an inherited disorder caused by the manifestation of cysts in the kidneys. Gradual growth of renal cyst results in kidney enlargement and renal insufficiency that subsequently leads to end-stage renal disease. The inheritance of PKD can be classified as autosomal dominant (ADPKD) or autosomal recessive (ARPKD). ADPKD patients typically develop kidney disease as adults, whereas ARPKD patients can in severe cases, express phenotypes as early as *in utero*. Although our understanding of PKD is becoming better understood throughout the recent years, conventional therapeutic approaches such as kidney dialysis or kidney transplantation remain the only treatments available.

Recent published work has shown a relationship between the misorientation of the actin cytoskeleton and manifestation of PKD. The cytoskeleton determines and maintains the structure of cells. Current literature shows that mutations in genes that cause ADPKD and ARPKD interact with components of the signalling pathway that control the assembly of the cytoskeleton. The Rho Family GTPase 3 gene (*Rnd3*) is a gene that encodes for a protein which is a member of the GTPase protein superfamily. The function of Rnd3 is to behave as a repressor of Rho-associated coiled-coil protein kinase 1, a pathway which is involved in cytoskeleton arrangement. Rho family proteins stimulate signalling pathways that influence actin cytoskeletal rearrangements through cell polarity, migration and cell cycle progression.

This investigation is based on a novel mouse model created by the International Mouse Phenotyping Consortium. From all the physiological systems examined in the designed mouse, the kidneys and heart were the most significantly affected;

phenotypes such as polycystic kidneys and enlarged heart were observed. The objective of the research project is to investigate the expression of Rho Family GTPase 3 gene (*Rnd3*). To explore the influences of Rnd3 in the manifestation of diseases in the kidneys and potentially secondary effects in the cardiovascular system. Identifying the role of the gene and the effect of the gene in relation to comorbidities that focus primarily on the heart and kidneys during development and adulthood will be a fundamental aspect of the investigation.

Precision-cut kidney slices obtained from mouse kidney, will be used to generate real-time 3D video reconstruction of the cells migrating in the kidney slice. To explore whether cells migrate, the rate of migration, and whether the cells form clusters. Another technique that will be used is *in situ* proximity ligation assay, a technique which identifies the physical proximity between proteins, which can be used to investigate the interaction between Rnd3 and components of relevant signalling pathways. A new 3D cell culture model that uses mouse inner-medullary collecting duct (mIMCD3) cells will be used to generate epithelial spheroids. Following the generation of spheroids, genetic modification will be used to silence the expression of Rnd3. The manipulation of Rnd3 expression will allow potential defects in cell proliferation, migration, adhesion, and cytoskeletal behaviour to be investigated. So far, the silencing of Rnd3 expression has been successful on mIMDC3 cells. Research into the mechanism of Rnd3 could possibly be a therapeutic potential in treating polycystic kidney diseases.

Investigating Genotypes to dissect the molecular mechanisms of Autosomal Recessive Polycystic Kidney Disease (ARPKD).

Taylor Richards, Patricia D. Wilson, Michael Tellier, Shona Murphy and Paraskevi Goggolidou

Abstract: There are 7000 known rare diseases and it is estimated that 3.5 million people living within the UK will be affected by a rare disease at some point in their life. A rare disease is defined as a disease that affects less than 5 in 10,000 individuals and because of their rarity, public awareness is often lacking. Research into these diseases is often limited due to funding, made worse by the range of symptoms and severity any singular rare disease can have.

An example of a rare disease is Autosomal Recessive Polycystic Kidney Disease (ARPKD). ARPKD presents with the formation of cysts within the kidneys and can result in liver scarring. The disease affects young children and results from DNA changes in the gene Polycystic Kidney and Hepatic Disease 1 (PKHD1). PKHD1 is required for cell communication and growth and is essential for kidney function. ATM Interactor (ATMIN) is a modifier gene that regulates PKHD1 activity and may play a role in the differences in disease severity witnessed in ARPKD patients.

Using mouse kidney (mIMCD3) cells, an Atmin mutant mouse model and human ARPKD kidney tissues, next generation sequencing technologies are being employed to further characterise the interactions between ATMIN and PKHD1. Whole Exome DNA Sequencing has confirmed the presence of two PKHD1 mutations in each of the ten ARPKD human kidney tissues used within this study, age-matched with 10 normal control human kidneys. This correlates with the recessive inheritance pattern of the ARPKD disease. PKHD1 mutations occur across multiple domains of the protein and in agreement with previous ARPKD reports, the position of the mutation does not seem to correlate with the severity of ARPKD. Within one sample, showing a less severe ARPKD phenotype, a mutation within ATMIN has been identified and this may play a role in the severity of the ARPKD phenotype. Data has been previously published showing that Atmin may control Pkhd1 expression. Chromatin Immunoprecipitation with Sequencing (ChIP-Seq) indicates a significant Atmin binding peak on Pkhd1, suggesting that Atmin may bind directly on Pkhd1, thus regulating its expression. Future work in mouse and human

tissue will enhance these findings and could potentially allow for better diagnosis and new treatment targets in patients with ARPKD.

Keywords: ARPKD; ATMIN; PKHD1; ChIP-Seq; DNA-Seq

Link to UNSDG: This work addresses UNSDG goal 3, Good Health and Well-being

The impact of robotics and artificial intelligence on pedagogy

Dan Moore, Amar Aggoun, Sarah Slater and Jeffery Ting

Abstract: Within the current climate of computer science, there has been a constant push for the development of social robots. Spanning from home assistants such as Google Home and Alexa to fully-fledged hotel receptionists in Japan, robots are making constant advances into our daily lives. However, there are still some areas where the social robots are in their relative infancy such as education.

The main area of research for this project is social robotics for educational purposes, as normally these robots are used as teaching aids to deliver material or to be part of the curriculum itself. While there are some platforms capable of delivering material autonomously, they have not been widely adopted in the educational setting. This project, I would like to investigate and research why this is, and how to combat one of the limiting factors in the effective deployment of these solutions. As of the current literature review, there are two primary limitations for the deployment of social robotic solutions, namely behaviour management, and effective human-robot interactions. As there is much research on HRI, this project will focus primarily on behaviour management and aims to develop a system which can detect certain behaviour trends within students.

While the project is in its relative infancy, work as started on the development of parts of the system, and a study onto how students interact with robots within there lessons has been undertaken. The findings of which are that while all genders and age groups show interest in the usage of robotics and artificial intelligence in their lesson's younger boys so a higher level when compared to all other age and gender groups.

The project anticipations with its competition to allow the future development of autonomous teaching robots which can be as effective as traditional teaching methodologies.

Keywords: behaviour management, artificial intelligence, pedagogy, secondary schools, human-robot interactions, autonomous teaching.

Link to UNSDG: This project hopes to pave to way for the future development of autonomous teaching to allow a reducing of pressure of traditional teachers and

recreated the tailored learning experience that many disadvantaged students require.

Study of Battery Management Systems used for residential and mini-smart grid applications for achieving grid independent operations

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Abstract: As a development from the United Nations Sustainable Development Goals (UNSDGs) which aims at proffering solutions to many of the world's challenges, such as Climate Change and replacing fossil fuel sources with sources which are Affordable and Clean Energy, it is imperative to intensify the rate of improvements on the generation and use of clean and renewable energy sources. Equally important is the need to have an environment void of the harmful gaseous substances which is continuously having adverse effect to good health and wellbeing of the human race. Renewable energy sources require storage batteries due to reliance on weather conditions which can affect stability. One of the mostly used storage battery is the lithium ion battery chemistry both for consumer electronics and industrial applications as a result of its properties like low self-discharge, high energy and power densities. With more research into this battery chemistry, there has been very remarkable decrease in cost of maintenance as compared to when it was first introduced in the past century. The recent realisation of the impact of use of fossil fuels on the environment has further driven the demand for alternative means of energy in the power generation sector and the automotive industry. Nations of the world have also intensified focus on renewable energy. Most of these applications require several batteries which can either be connected in series or parallel to take care of the power demand. Lithium ion batteries in particular need to operate within safe limit. This is due to each cell having variations in certain properties which include operating temperature and capacity due to manufacturing processes. When not used within the prescribed limits it could lead to very fatal consequences like fire. It is therefore required to have a battery management system to ensure the safety of both the battery pack and the entire system using the battery. Battery Management system reads voltages and temperature from the cells including the temperature, current and voltage inputs from sensors. These inputs are then processed with the aim of making decisions based on prescribed operating limits set by the manufacturer and generate a report for the sake of monitoring. The BMS also has the ability to shut down the system in the event of abnormal or unsafe condition thereby protecting the battery and the equipment. This paper concerns a study of the

Battery Management Systems used for residential and mini-smart grid applications for achieving grid independent operations. The paper also looks at the current challenges and developments in BMS research and developments.

Keywords: Power generation Lithium-ion batteries, battery safety, stability, sensors, thermal runaway, capacity variations


SUSTAINABLE DEVELOPMENT GOALS
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS